SUMMER– 17 EXAMINATION

Model Answer Subject Code: 17673

Important Instructions to examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.

2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.

3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).

4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.

5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.

6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.

7) For programming language papers, credit may be given to any other program based on equivalent concept.

SUMMER – 17 EXAMINATION

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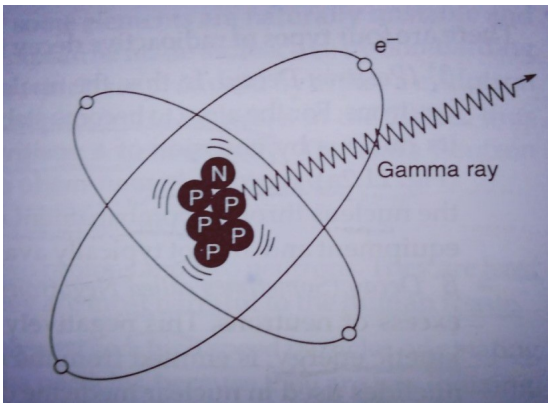
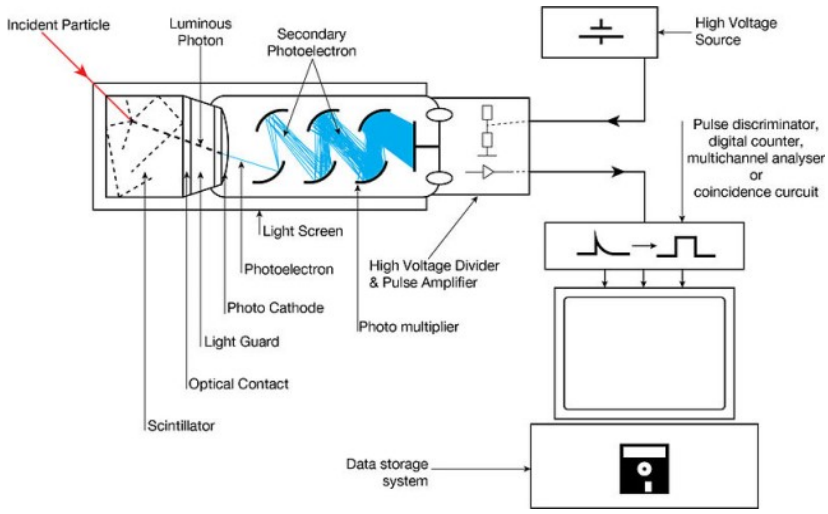
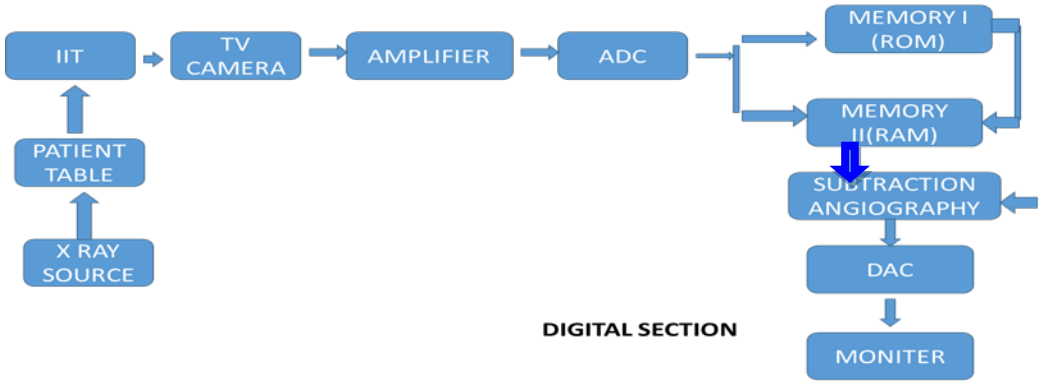
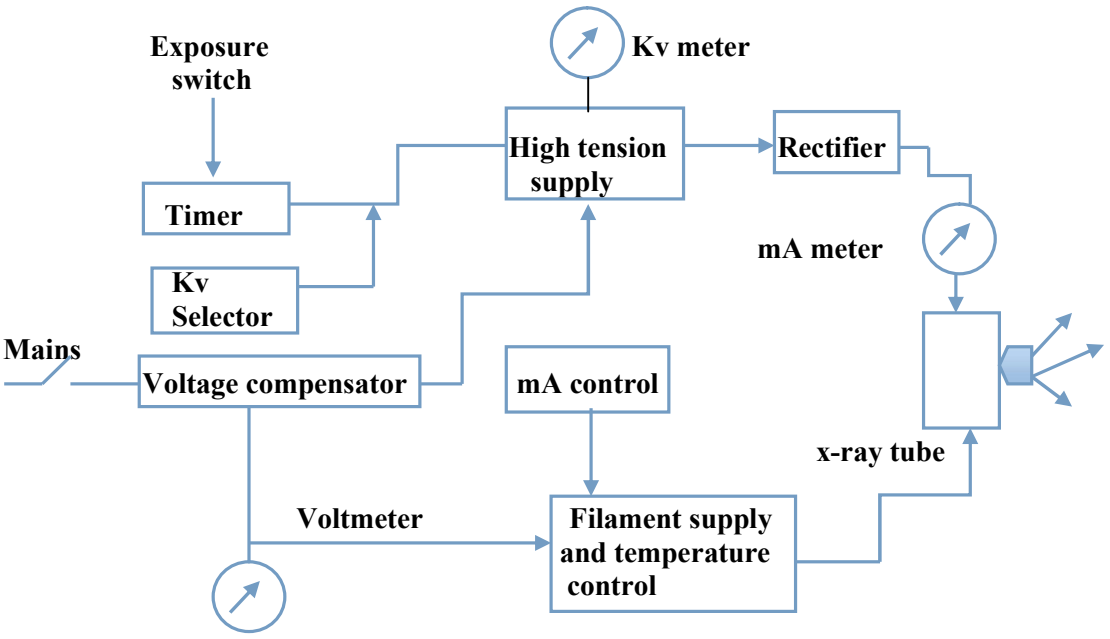
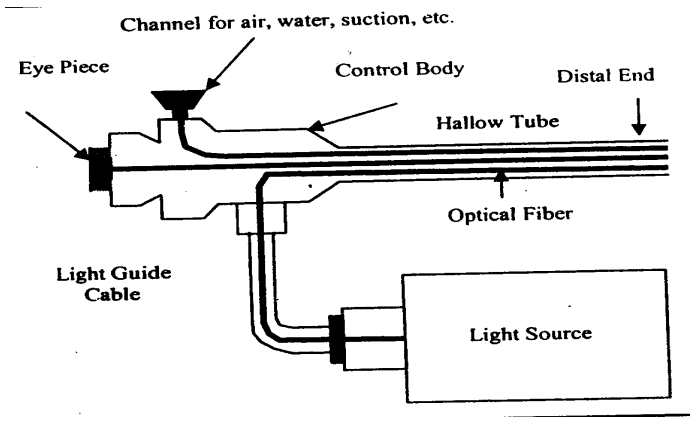
Q. No.	Sub Q.N	Answer	Marking Scheme
Q.1	**(A) a)**	**Attempt Any three of the Following.** **With the help of diagram give working of radioisotopes. (2m+2m)** **Ans :**  **Radioisotope :Gamma Radiations** Isotopes which exhibit radioactivity are called Radioisotopes. The nucleus of a radioisotope is unstable. In an attempt to reach a more stable arrangement of its protons and neutrons, the nucleus will spontaneously decompose to form a different nucleus. If the number of neutrons changes in the process, a different isotope is formed. If the number of protons changes in the process, then an atom of a different element is formed. This decomposition of the nucleus is referred to as radioactive decay. During radioactive decay an unstable nucleus spontaneously decomposes to form a different nucleus, giving off radiations (emitting alpha, beta, or gamma rays until stability is reached.) In the form of atomic particles or high energy rays. The stable end product is a nonradioactive **isotope** of another element This decay occurs at a constant, predictable rate that is referred to as half-life. Eg Iodine-131, Technetium-99 are used in Nuclear Medical Imaging.	**12** **4 marks**
	b) i	**Give any two installation steps to install ultrasound machine. (2m)** **Ans :** Steps involved are as follows (any two) • Prepare lab area for installation machine. • Check electrical supply connection • Unpack the box. • Read user manual carefully. • When equipment arrives, it will be necessary to record the fact and to check that everything has been supplied that was ordered. It will also be necessary to check that the equipment is supplied in the right way. • Assemble all accessories of equipment. • Connect monitor scan control panel and ultrasound probes. • Check position of curser on the monitor by placing the electrode on sample.	**4 marks**

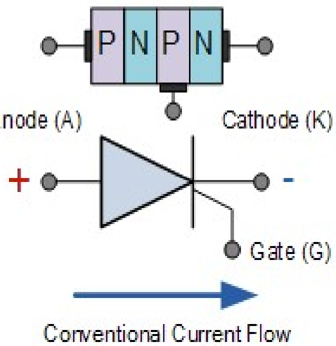
		• Perform quality test on equipment • Perform demo test	
	ii	**For following faults occur in the ultrasound m/c give(suggest) remedies:(2m)** **1) Machine does not start** **2) Ultrasound waveform does not generated** **Ans** : **(Any one remedy for 1 mark each)** 1) Machine does not start - i)Check power switch is on. Replace fuse with correct voltage and current if blown. ii) Check if mains power is present, Contact electrician for rewiring if power not present or else make a cable check on different equipment, call the electrician. 2)Ultrasound waveform does not generated – i)Check various control knob settings for proper operation ii) Check the probe, go for an onboard CRT check .	
	c)	**Give significance of relaxation process in NMR imaging. Define T1 & T2 relaxation time. (2m+2m)** **Ans** : **Significance of relaxation process in NMR imaging.-----** In Nuclear Magnetic Resonance (NMR) the term relaxation describes how signals change with time. In general signals deteriorate with time, becoming weaker and broader. The deterioration reflects the fact that the NMR signal, which results from nuclear magnetization, arises from the over-population of an excited state. Relaxation is the conversion of this non-equilibrium population to a normal population. In other words, relaxation describes how quickly spins "forget" the direction in which they are oriented. **OR** Relaxation processes play a crucial role in NMR. In imaging, variations in relaxation times among different biological tissue types provide the key contrast mechanism for anatomical discrimination. In a diseased state, the differences in relaxation time relative to the normal values can be greater than 100 % , thereby providing a powerful mechanism for the detection of pathology. Imaging capabilities of these two important parameters (T1 and T2) together with the proton densities of the objects thus make NMR imaging a unique, versatile and powerful technique in medical imaging. **Definition T1 and T2** **Relaxation time T1-** It is referred to as the spin-lattice relaxation process as it characterizes the time for perturbed nuclei to realign themselves with the existing lattice structure of the host material. This is also called longitudinal relaxation. As it is the time constant that describes the recovery of the z-component of M to its equilibrium value M0 which is along the direction of the applied magnetic field. **Relaxation time T2-** It is called spin-spin relaxation as it indicates the time required for perturbed, in-phase spins to de-phase with respect to eachother.It is also called Transverse relaxation process as it is relation to the decay of the component of M in X-Yplane which is conventially perpendicular to the Z axis. **OR** **Relaxation time T1** - Time taken for magnetic vector to return to its resting state. **Relaxation time T2** – Time needed for the axial spin to return to its resting state.	**4 marks**

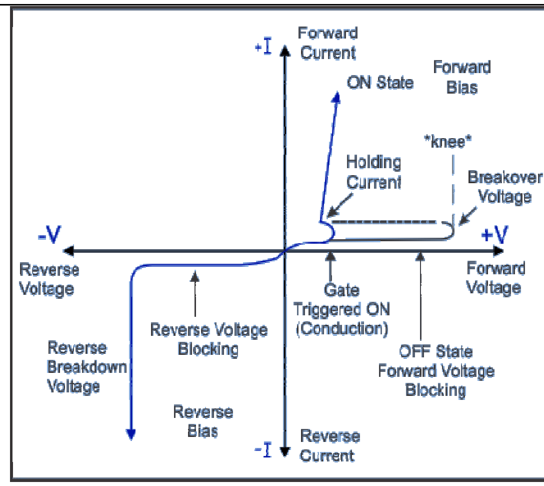
	d)	**Draw and label a Geiger Muller Tube.** **Ans:**  **Fig : Geiger Muller Tube**	**4 marks**
	B) **a)**	**Attempt any ONE of the following.** **Give significance of angiography. Draw and explain block diagram of angiography. List application of angiography tech.(2m+3m+1m)** **Ans : Significance of angiography :** It is a diagnostic & therapeutic procedure which is related to the disease of circulatory system This procedure is carried out by using or by inserting contrast material called as radioisotopes mostly iodine containing compound which is radioactive in nature is used. The contrast material provides radiographic image which is viewed on TV screen they are recorded as a film or video. It is invasive method that helps the physician to diagnose & treat the medical condition. **Block diagram of angiography:**  X ray source: It is used to pass narrow x ray beam to the patient. Patient table: patient lies on the table. IIT: The reflected x rays are collected by IIT unit in which brightness of image is increased & output is displayed on fluorescent screen.	**06** **6marks**

		Amplifier: It amplifies the output of image intensifier tube and gives it to the ADC where signal is converted into digital form. Memory i& ii : digitally converted signal is stored into the ram & rom memory Subtraction angiography: Digital subtraction angiography refers specifically to techniques which subtract two images that are obtained before and after contrast media is administered to the patient for the purposes of studying blood vessels (angiography). DAC: it converts digital signal into analog signal. Monitor: by using TV camera unit we can see the clear & live image of an patient body on monitor. **Applications:** (any one) 1)Coronary Angiography-- performed is to visualize the blood in the coronary arteries 2) Micro angiography --is commonly used to visualize tiny blood vessels. 3) Neuro-vascular ---in order to visualize the arterial and venous supply to the brain. 4)Peripheral Angiography-- is also commonly performed to identify vessels narrowing in patients with leg claudication or cramps.	
	b)	**Draw labelled diagram of X-ray machine. Which controls in the x-ray machine are responsible for:(4m+2m)** **i) Quality of X-rays** **ii) Quantity of x-rays** **Ans:-**  i) Quality of X-rays--- KVp control ii) Quantity of x-rays---mA control	**6marks**
Q2	**a)**	**Attempt any Four of the following** **What is CT number or Hounsfield unit (H)? Indicate the CT No for water and air. (2m+2m)** **Ans :** CT number:- Linear attenuation coefficient of tissue is known as CT number. It is represented as integers that usually range in values from -1000 to + 1000. It is denoted by Hounsfield unit (H)	**16**

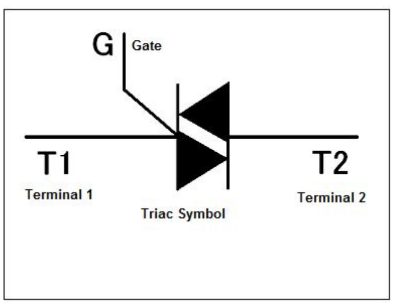
		$H = \frac{\mu - \mu_{water}}{\mu_{water}} \times 1000$ where μ= attenuation coefficient of tissue μ_{water}= attenuation coefficient of water CT number for water is **0** CT number for air is **– 1000**	**02** **02**
	b)	**State properties of ultrasound (any four).** **Ans:** 1) Frequency of Ultrasound is above 20 kHz. 2) Ultrasound travels at a velocity of about 1500m/s in soft tissue of the body. 3) The velocity of ultrasound waves in various biological media is approx. the same and nearly equal to that in water. 4) Velocity in bone about 3 times higher and in air it is 3 times less. **(Any other relevant points should be considered)**	**4 marks**
	c)	**State the meaning of word 'Endoscope' and draw the block diagram of endoscopy machine. (2m+2m)** **Ans :** The meaning of word 'Endoscope'- Endo –that is inside or within internal and scope- here is to view Thus we say endoscope is an medical instrument used to view and investigate internal body organs of the body.  **Endoscope**	**4 marks**
	d)	**Draw symbol and V-I characteristics of (2m+2m)** **i) SCR** **ii) TRAIC** **Ans:**	**4 marks**

<table>
<tr><th>Symbol</th><th>VI characteristic</th></tr>
<tr><td>SCR



</td><td>


</td></tr>
<tr><td>TRAIC



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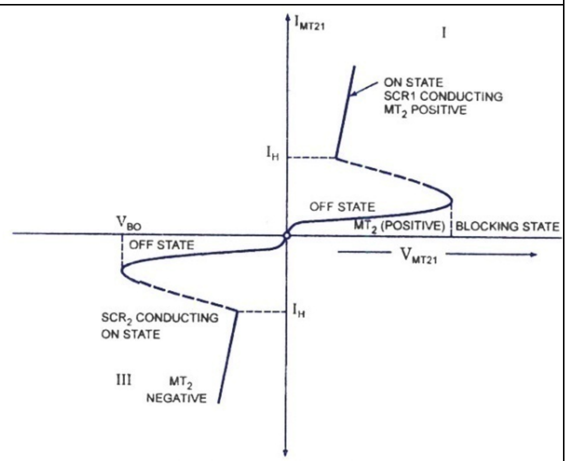


V-I Characteristic of a Triac
</td></tr>
</table>

e)	**Define the term maintenance and state the steps carried out in maintenance of angiography machine. . (1mDefination+3m for any three steps)**	**4 marks**

Ans:

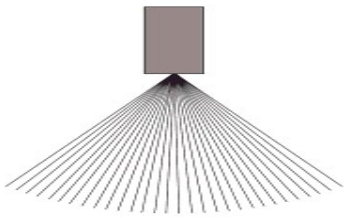
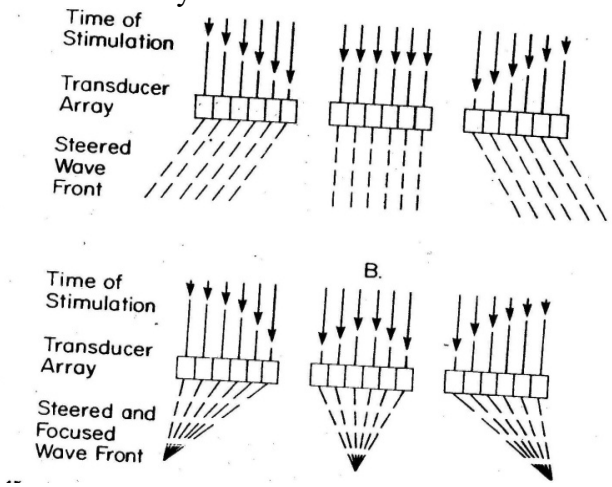
Maintenance :

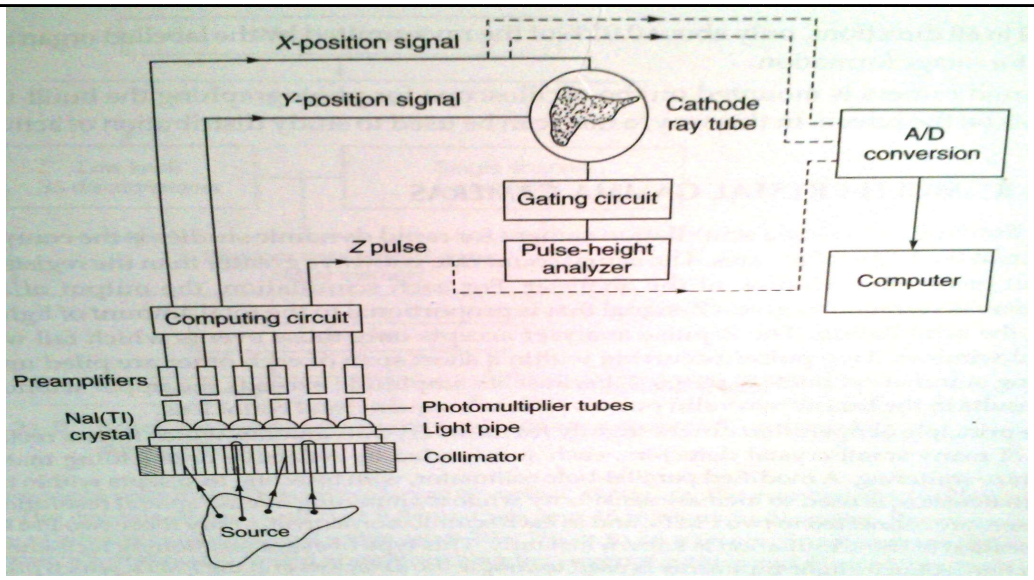
It is the defined as procedures which are used to minimize the risk of failure and to ensure continuous proper operation of equipment.

Maintenance of angiography:

- Maintenance must be performed in the normal mode.
- Check Program: Check Program must be performed in the normal mode.
- perform calibration and maintenance with a personal computer, it is necessary to prepare the following:
- Personal computer where the Windows 95 / 98 has been installed.
- Adjust the DC power of the board surely because it is used as a reference voltage for A/D conversion. This adjustment should be made with all the units connected, including the Display Unit, console, and options.
- Check calibration for motor of arm

		• Check calibration of position table for its up down movement. • Check collimator alignment and its position • Check x ray tube alignment & its position. • Check shutter & filter calibration. • Check battery & maintain cover. • Update software periodically. • Check TV camera connections ,IIT,XRAY TUBE (any other relevant answer should be consider as a valid answer)	
	f)	**List out the points while handling CT and MRI machine.(any four)** **(2m for CT+2m for MRI)** **Ans:** **CT scan protocols while handling.** Dose given: Dose of radiation should not be more than what is needed to provide a quality Radiograph for radiologist to read. Shielding: When radiation is used, the patient should be shielded to block radiation from reaching body parts that do not need to be imaged. Shielding is usually lead that lines the inside of a piece of fabric Motion**:** Children's most difficult patients to image.as sometimes they are reluctant to hold still. Result can be motion artifacts or blurred images. Rendering image not suitable for diagnosis. Limit Exams: When it comes to children or pregnant women's CT should not scan more than area of interest. Goal should be only one scan. The exposure to ionizing radiation may cause a small increase in a person's lifetime risk of developing cancer. A special dye called a contrast material through a vein in arm of patient before CT scan which can cause medical problems or allergic reactions. **MRI scan protocols while handling.** Medical Alert cards should be checked of patients. Cards state whether or not implant of patient is MRI compatible. Cards should be checked by radiologists. There is possible damage to MRI scanner due to ferromagnetic objects as they magnetize themselves, hence should not be possessed by technologists or patient entering the MRI room. It takes 4 days to remove the object and to repower the scanner. Noise : Loud noise due to magnets is generated while undergoing an MRI scan hence special ear protections must be provided to the patients Metallic chips, materials, surgical clips, or foreign material (artificial joints, metallic bone plates, or prosthetic devices, etc.) can significantly distort the images obtained by the MRI scanner. Patients who have heart pacemakers, metal implants, or metal chips or clips in or around the eyeballs cannot be scanned with an MRI because of the risk that the magnet may move the metal in these areas.	**4 marks**

Q.3		**Attempt any Four**	**16**
	a)	**Enlist the transducers used in ultrasound. Give working of phased array transducer.** **Ans :** Transducers used in ultrasound imaging (2m+2m) linear array transducer Phased array transducer **Phased array transducer** Phased array transducer produces a sector scan format in which scan line spread in fan like formation from a point in the center of the transducer face. As shown in fig  Sector scan format of phased /steered array scanner Electronic focusing, is based on the use of electronic delays applied during emission and reception along each of the channels of the probe. These delays have an effect similar to that of a focusing lens and enables focusing to different depths. Electronic focusing allows only one phased array probe to be used where several single-element probes with different focal distances would be necessary. Beam can be steered or directed to a desired angle by a similar mechanism of time delays. By choosing the appropriate time delay between the simulations of the individual elements of the transducer, it is possible to steer the beam or to steer and focus the beam simultaneously. 	**4marks**
	b)	**Draw an neat labelled block diagram of Gamma Camera and write importance of i) Pulse- height Analyzer ii) Computing circuit.(2m+2m)** **Ans :**	**04 marks** **02 marks**



Gamma Camera

01

i) Pulse- height Analyzer

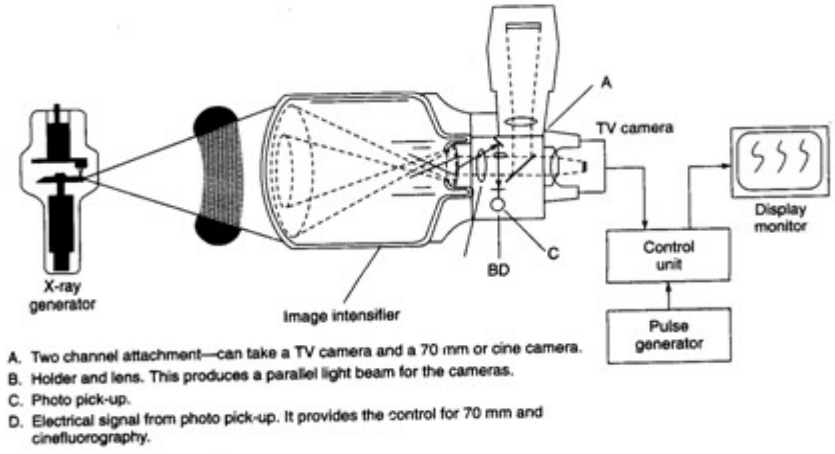
In Radioactivity measurements, the individual particles are detected as single electrical impulses in detector. The particular particle produces an electrical impulse with height proportional to energy of particle. The measurement of pulse height is thus a useful tool for energy determination. Thus in order to sort out pulses of different amplitude and to count them electronic circuits are employed, which are called as pulse height analyzers

01

ii) Computing circuit.

Function - The output voltages generated by these PM tubes are fed to a position circuit which produces four output signals called ±X and ±Y. These position signals contain information about where the scintillations were produced within the crystal. In the most basic gamma camera design they are fed to a cathode ray oscilloscope. The position signals also contain information about the intensity of each scintillation. This intensity information can be derived from the position signals by feeding them to a summation circuit which adds up the four position signals to generate a voltage pulse which represents the intensity of a scintillation. This voltage pulse is commonly called the Z-pulse which, following pulse height analysis, (PHA) is fed as the unblank pulse to the CRO.So we end up with four position signals and an unblank pulse sent to the CRO.

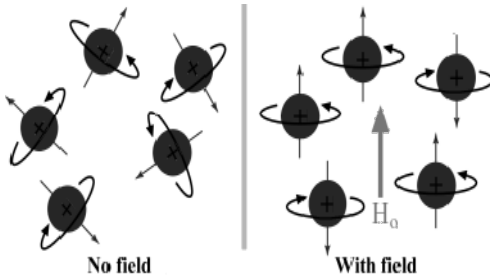
	c)	**State principle of Fluoroscopy. Draw labelled block diagram of fluoroscopy. (2m+2m)** **Ans:** Fluoroscopy is a technique for obtaining "live" X-ray images of a living patient. The Radiologist uses a switch to control an X-Ray beam that is transmitted through the patient. The X-rays then strike a fluorescent plate that is coupled to an "image intensifier" that is (in turn) coupled to a television camera. The Radiologist can then watch the images "live" on a TV monitor.	**4marks**



A. Two channel attachment—can take a TV camera and a 70 mm or cine camera.
B. Holder and lens. This produces a parallel light beam for the cameras.
C. Photo pick-up.
D. Electrical signal from photo pick-up. It provides the control for 70 mm and cinefluorography.

Fluoroscopy

	d)	**State the causes and remedies of the following faults occur in X-ray(1m each)** **i) Does not switch on** **ii) X-ray does not expose even power is on** **iii) X-ray table does not move** **iv) Give electrical shock** **Ans : (consider any 01 remedy)** **i)** Does not switch on Cause: Mains supply is not proper. Action taken: 1. Move position of mains compensator control. 2. Check mains fuses, faulty connection in switch replace if defective. **ii)**X-ray does not expose even power is on Cause: Exposure pushbutton switch problem. Action taken: 1.) Check Rotor pushbutton switch to start rotor and pre exposure. 2.) Check AEC (Automatic exposure control) switch circuitry. **iii)** X-ray table does not move Cause: The moving parts of the tables get jam.(wheel locks) Action taken: 1) Regularly clean and oil all moving parts of table. 2) Check the hand and foot locks. iv)Give electrical shock Cause: Wiring fault Action taken: Refer to an Electrician.	**4marks**
	e)	**State the basic principle of NMR with diagram.(2m+2m)** **Ans :** Magnetic Resonance Imaging Magnetic Resonance imaging is a technique used to produce detailed images of any part of the body. It is a map of the distribution density of hydrogen nuclei and parameter reflecting their motion, in cellular water and lipids	**4 marks**



- Hydrogen nucleus is present in every cell of our body. For imaging purposes the
- hydrogen nucleus (a single proton) is used because of its abundance in water and fat.
- Hydrogen atoms behaves like a small bar magnet. Under normal,

these hydrogen proton "bar magnets" spin in the body with their axes randomly aligned.

- When the body is placed in a strong magnetic field, such as an MRI scanner, the protons' axes all line up. This uniform alignment creates a magnetic vector oriented along the axis of the MRI scanner.
- When the radiofrequency source is switched off the magnetic vector returns to its resting state, and this causes a signal (also a radio wave) to be emitted. It is this signal which is used to create the MR images.
- Multiple transmitted radiofrequency pulses can be used in sequence to emphasize particular tissues or abnormalities. A different emphasis occurs because different tissues relax at different rates when the transmitted radiofrequency pulse is switched off.
- The time taken for the protons to fully relax is measured in two ways. The first is the time taken for the magnetic vector to return to its resting state and the second is the time needed for the axial spin to return to its resting state. The first is called T1 relaxation; the second is called T2 relaxation.
- An MR examination is thus made up of a series of pulse sequences.
- Most diseases manifest themselves by an increase in water content, so MRI is a sensitive test for the detection of disease.

Q4 **(A) a)** **Attempt any three of the following:** **12 marks**

State and give significance of each block of MRI detection system. **4 marks**

Ans :(any four blocks 01 mark for each)

MRI scanner consists of following blocks:

1) Primary Magnet 2) Gradient Magnet 3) R.F. equipment
3) Computer 5) Data Storage 6) Display and control.

- Primary magnet consists of either a resistive , superconductive or permanent magnet which provides the uniform magnetic field around the patient.
- The gradient magnet system consists of auxiliary sets of x, y and z gradient magnet coils. These coils are driven by high-power audio amplifiers that can rapidly turn on and off to provide for signal localization.
- The R. F. equipment consists of a transmitter capable of applying RF pulses in narrow frequency bands. It has also a broad band receiver and computer controlled switching mechanism to rapidly turn on and off at the appropriate times.
- The system computer controls all these devices as well as performs the Fast Fourier Transforms necessary for assigning X, Y, Z coordinates.
- The data is stored as a number of arrays that are displayed under computer control

as a video image on display system.

b) Differentiate between Thermography and Endoscopy based on following points. **4 marks**

1. **Basic principle**
2. **Application techniques**
3. **Adv. And Dis.**
4. **Specific application of each**

Ans :

Principle	Principle of Thermography : The principle of infrared thermography is based on the physical phenomenon that any body of a temperature above absolute zero (-273.15 °C) emits electromagnetic radiation. There is clear correlation between the surface of a body and the intensity and spectral composition of its emitted radiation. By determining its radiation intensity the temperature of an object can thereby be determined in a non-contact way.	Principle of Endoscopy Endoscope cables carries light from a bright lamp in the operating room into the body, illuminating the cavity where the endoscope has been inserted. The light bounces along the walls of the cable into the patient's body there by making viewing easy for diagnosis.
Application Technique	Patient will be positioned in front of the imaging system so that the surfaces of the body are imaged. The images are captured in real-time from an ultra-sensitive medical infrared imaging camera and sent to a sophisticated computer for storage and analysis	Surgeon inserts an endoscope through a small cut, or an opening in the body such as the mouth. An endoscope is a flexible tube with an attached camera that allows your doctor to see. Your doctor can use forceps (tongs) and scissors on the endoscope to operate or remove tissue for biopsy/ only viewing
Advantage (Any one)	It shows a visual picture so temperatures over a large area can be compared It is capable of catching moving targets in real time It is able to find deteriorating, i.e., higher temperature	Minimal morbidity Minimal mortality, No scars due to natural body opening is used. Quick recovery time

			components prior to their failure	Less time in hospital	
		Disadvantage (Any one)	Images can be difficult to interpret accurately when based upon certain objects, specifically objects with erratic temperatures,	Perforation of an organ Excessive bleeding. Infection Allergic reaction to anesthesia	
		Specific application	Breast screening Thyroid examination	Examination of Gastrointestinal tract	
	c)	**List medical applications of X-ray (any four)** **Ans:** **i)** Radiation therapy: It is the treatment using penetrating x-rays, on the affected region of the body to destroy the cancer cells. **ii)** Radiography: It is the use of ionizing electromagnetic radiation such as X-rays to view objects. **iii)** Mammography is an X-ray examination of breasts and other soft tissues. This has been used mostly on women to screen for breast cancer **iv)** Angiography is the use of fluoroscopy to view the cardiovascular system.			**4 marks**
	d)	**Draw the flowchart for installation of Angiography machine. (2m only steps+2m flowchart)** **Ans :** (any other relevant answer should be consider as a valid) Refer page number 22 and 23			**4 marks**
Q.4	**(B) a)**	**Attempt any ONE of the following :** **State types of maintenance. Give maintenance steps involved in x-ray machine (any eight) (2m+4m)** **Ans:The types of maintenance (any 02 types 01 mark for each)** **1) Corrective maintenance:** The set of tasks is destined to correct the defects to be found in the different equipment and that are communicated to the maintenance department by users of the same equipment. **2) Preventive Maintenance:** Its mission is to maintain a level of certain service on equipment, programming the interventions of their vulnerabilities in the most opportune time. It is used to be a systematic character, that is, the equipment is inspected even if it has not given any symptoms of having a problem. **3) Predictive Maintenance:** It pursues constantly know and report the status and operational capacity of the installations by knowing the values of certain variables, which represent such state and operational ability. **4) Periodic maintenance (Time Based Maintenance TBM):** the basic maintenance of equipment made by the users of it. It consists of a series of elementary tasks (data collections, visual inspections, cleaning, and lubrication, retightening screws.			**6 Marks**

Maintenance steps for x-ray machine

. 1.Look for physical damage that could affect radiation shielding
(i.e., hole in the wall, broken window, broken collimator glass or shutter, any type of damage which would allow radiation leakage from the room or the machine).

2. Ensure that the x-rays are inhibited when in the Positive Beam Limitation (PBL) model and not at 40" or 72" SID.

3. Ensure that x-rays are inhibited when EXPHOLD lamp is illuminated RED.

4. When collimator filter is off, and kV is greater than 49kV, exposures must be inhibited. The READY light will turn off

5. Wipe down the x-ray control unit and a soft cloth every day before leaving.

6. Maintenance of control panel should be

7. Never open the x-ray control unit.

8. Never place food or drink on the X-ray Control Unit.

9.Performance tests should be carried out

10. Measuring or testing the performance of exposure.

b)i) Define:(2m)

1) Fluoroscopy

2) Radiography

Ans :

1) **Fluoroscopy:** Is an imaging technique that uses X-rays to obtain real-time moving images of the interior of an object. In its simplest form, a fluoroscope consists of an X-ray source and a fluorescent screen, between which a patient is placed. **01**

2) **Radiography:**
The making of film records (radiographs) of internal structures ofthe body by pass ing x-rays through the body to act on specially sensitized film. **01**

ii) Differentiate between Radiography and Fluoroscopy based on: (4m)

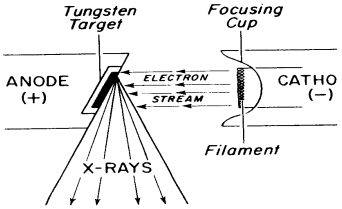
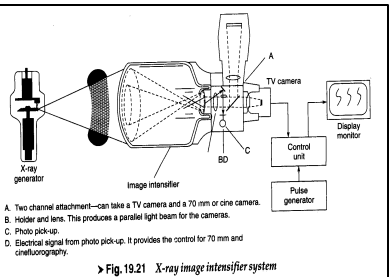
1)Diagram

2)Working principle

3) Viewing media

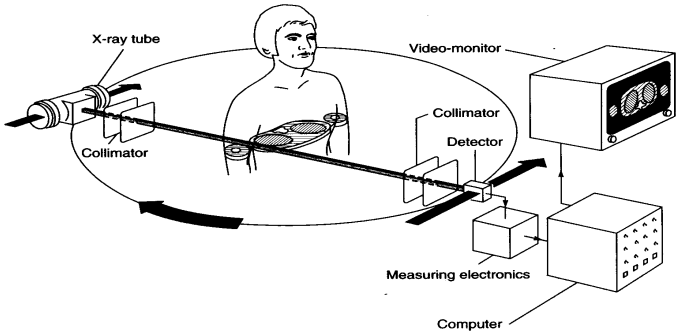
4) Application

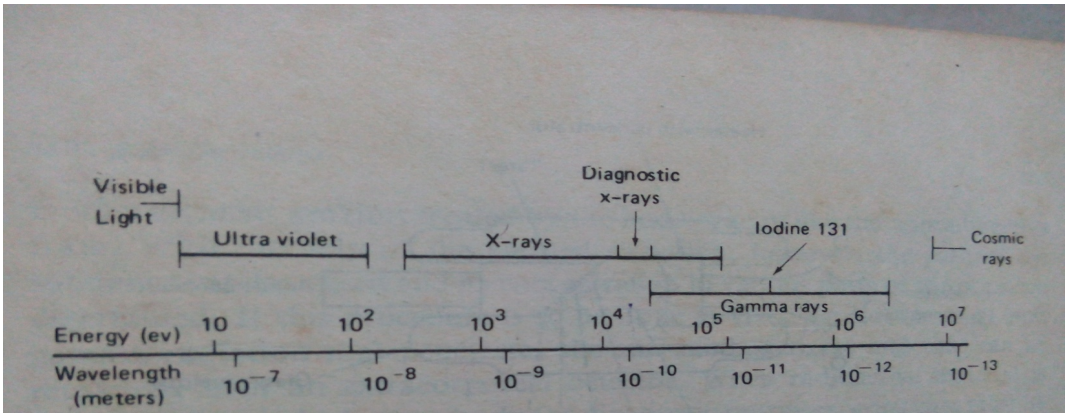
Ans :

Diagram	 **Figure 2–4** Lateral view of the cathode a anode of a stationary anode x-ray tube	 Fig. 19.21 *X-ray image intensifier system*
Principle	Radiography is an imaging technique that uses electromagnetic	Fluoroscopy is a technique for obtaining "live" X-ray images of a living patient - it is like an X-ray TV

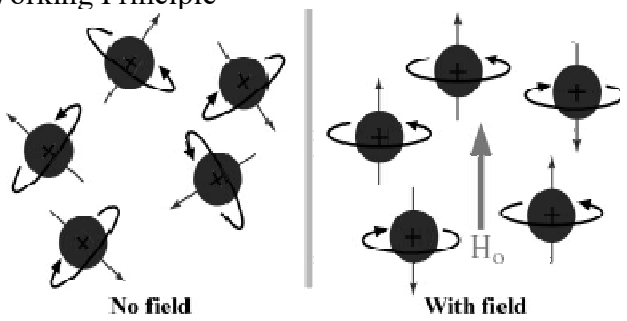
			radiation other than visible light, especially X-rays, to view the internal structure of a non-uniformly composed and opaque object (i.e. a non-transparent object of varying density and composition) such as the human body	camera. The Radiologist uses a switch to control an X-Ray beam that is transmitted through the patient. The X-rays then strike a fluorescent plate that is coupled to an "image intensifier" that is (in turn) coupled to a television camera. The Radiologist can then watch the images "live" on a TV monitor		
		Viewing media used	Radiographic film	TV camera		
		Application (any one)	1. X ray: x rays are used for to detect cracks, fractures in bones. 2. It is also used for killing cancerous cells 3. CT scan: CT scanning is used for diagnosing some urgent and emergent conditions, such as cerebral hemorrhage, pulmonary (clots in the arteries of the lungs), aortic dissection (tearing of the aortic wall), appendicitis, diverticulitis, and obstructing kidney stones. Ultrasound: it is used for obtain images of almost entire range of internal organs in abdomen .development of fetus during development. Thermography: it gives video of temperature distribution over the surface of the skin. NMI: used to detect biochemical process are occurring normally and where they are occurring too slowly or	1. To obtain real-time moving images of the internal structures of a patient 2. Investigations of the gastrointestinal tract, including barium enemas, defecating proctograms, barium meals and barium swallows, and enteroclysis. 3. Orthopedic surgery to guide fracture reduction and the placement of metalwork. 4. Angiography of the leg, heart and cerebral vessels. 5. Placement of a PICC (peripherally inserted central catheter) 6. Urological surgery 7. Cardiology for diagnostic angiography, 8. Implementation of pacemakers, implantable cardioverter		

			quickly. MRI: To obtain anatomical information about human body	defibrillators and car diac resynchronization devices) 9. Discography, an invasive diagnostic procedure for evaluation for intervertebral disc pathology.		
Q5		**Attempt any four of the following:**				**16**
	a)	**An endoscope has following defects. What can be the reasons for these? (2m+2m)** **i)There is no fluid flow** **ii) There is a leakage in flexible endoscope.** **Ans:** **i) There is no fluid flow** Cause : blocked air /water nozzle Loose or damage setscrew **ii) There is leakage in flexible endoscope**. Cause : Tears or cut in flexible shafts				**4 marks**
	b)	**Define pulse echo techniques. Give its significance in case of ultrasound.(2m+2m)** **Ans :** A diagnostic technique in which short duration ultrasound pulses are transmitted into the region to be studied, and echo signals resulting from scattering and reflection are detected and displayed. Depth of reflective structure is inferred from the delay between two pulse transmission and echo reception. Pulse echo based equipment is used for the detection and location of defects or abnormalities in the structures at various depths of the body. This is possible because the time of travel of short pulse can be measured with much greater ease as compared to continuous wave. With this technique the presence of discontinuity can be conveniently established and its position located. Also it is possible to determine the magnitude of the discontinuity and access the physical size.				**4 marks**
	c)	**State the biological effects of MRI imaging (any four).** **Ans :** Biological effects/hazards of MRI imaging • If patients with cardiac pacemakers, cerebral aneurysm clips or other metallic foreign body undergo for MRI then due to strong magnetism, these devices can malfunction or get damaged. Same holds true for • implanted electrode such as neuro stimulator and bone growth stimulator or internal drug diffusion pump • Time varying magnetic fields induce currents in patients which can produce muscle contraction and cardiac arrhythmia. • It can cause the augmentation in T wave of ECG. • It can cause deafness in the patient				**4 marks**

	d)	**List out risk factors involved in handling of X-ray Equipment's.(any four)** **Ans :** The safe annual exposure to the radiation to the persons handling is inversely proportional to the number of years working in that area. Risk factors involved in handling of x ray equipment are: i) X rays are highly absorbed in soft tissue, and severe burns can result from exposure of the hands, arms, skin or eyes to the direct or diffracted beams. ii) High dose can cause reddening of the skin or erythema. iii) Loss of hair or epilation iv) If a large area of skin is irradiated, erythema and pigmentation will occur with the pigmentation eventually fading. v) If enough radiation of the proper energy is absorbed in the skin this will result in permanent destruction of either hair or sweat glands, or whole skin, with a resulting scar. vi) It can cause chronic radiation dermatitis, Radiation cancer. vii) It can affect fetus if it is used for pregnant women.	**4 Marks**
	e)	**List two X-ray tube ratings e.g. one X-ray tube is having KVP rating 60KVP, miliampere rating 60mA and X-ray emits for 10 seconds. Calculate the heat unit value (HU) for this tube.(2m+2m)** **Ans :** X ray tube ratings are • Electrical rating • Thermal rating HU value for this tube is calculated as follows. HU = KVp x mA x S = 60 KVp x 60 mA x 10secs = 36000 HU	**4 marks**
	f)	**Enlist various image reconstruction techniques used in CT. Also draw block diagram for CT machine.(2m+2m)** **Ans:** Various image reconstruction techniques used in CT are: a) Back projection b) Iterative methods c) Analytical methods : 1) Filtered back projection 2) Fourier reconstruction technique  	**4 marks**

		Block diagram of CT scanner consist of following parts 1. X ray tube 2. Collimator 3. Detectors 4. Measuring electronics 5. Display	
Q6)		**Attempt any four of the following:**	**16**
	a)	**Draw and explain electromagnetic spectrum.(2m+2m)** **Ans :**  Electromagnetic Spectrum There are different types of radiation each with its own distinct properties such as Alpha rays, Beta rays, Gamma rays and X-rays. X-rays are electromagnetic radiation located at the low wavelength end of electromagnetic spectrum. X-rays have wavelength of the order 10^{-10} m. They propagate with the speed of $3x10^{10}$ cm/s and are unaffected by electric and magnetic fields. In X-rays wavelength is directly dependent on the voltage with which the radiation is produced. Because of short wavelength and extremely high energy, X-rays are able to penetrate through materials which readily absorb and reflect visible light. X-rays are absorbed when passing through the matter. X-rays are produced whenever electrons collide at very high speed with matter and are thus suddenly stopped. The energy possessed by the electrons appears from the site of collision as a parcel of energy in the form of highly penetrating electromagnetic waves (X-rays) of many different wavelengths, which together form a continuous spectrum.	**4 marks**
	b)	**Which imaging tech. can be used to diagram diff. brain tissues, normal and coagulated blood? Give its working principle. (2m+2m)** **Ans : - (any other relevant imaging technique to be considered)** MRI-Magnetic resonance imaging is the technique which can be used to diagram diff. brain tissues, normal and coagulated blood.	**4 marks**

Working Principle



- Hydrogen nucleus is present in every cell of our body. For imaging purposes the
- hydrogen nucleus (a single proton) is used because of its abundance in water and fat.
- Hydrogen atoms behaves like a small bar magnet. Under normal,

these hydrogen proton "bar magnets" spin in the body with their axes randomly aligned.

- When the body is placed in a strong magnetic field, such as an MRI scanner, the protons' axes all line up. This uniform alignment creates a magnetic vector oriented along the axis of the MRI scanner.
- When the radiofrequency source is switched off the magnetic vector returns to its resting state, and this causes a signal (also a radio wave) to be emitted. It is this signal which is used to create the MR images.
- Multiple transmitted radiofrequency pulses can be used in sequence to emphasize particular tissues or abnormalities. A different emphasis occurs because different tissues relax at different rates when the transmitted radiofrequency pulse is switched off.
- The time taken for the protons to fully relax is measured in two ways. The first is the time taken for the magnetic vector to return to its resting state and the second is the time needed for the axial spin to return to its resting state. The first is called T1 relaxation; the second is called T2 relaxation.
- An MR examination is thus made up of a series of pulse sequences.

Most diseases manifest themselves by an increase in water content, so MRI is a sensitive test for the detection of disease.

c) List out technical specifications of ultrasound scanner. Give importance of any two specifications.(2m+2m) — **4 marks**

Ans :

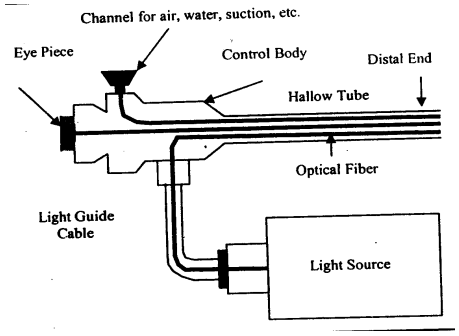
Specification**:(any 02)**

1) Power supply – 230 V AC 50 Hz
2) Frequency range – 1 to 15 MHz
3) Scan time – 1 to 3 s
4) Eco signal intensity – up to 80 dB
5) Storage capacity - 512 Mb
6) Transducer technique (phased array)

Importance:

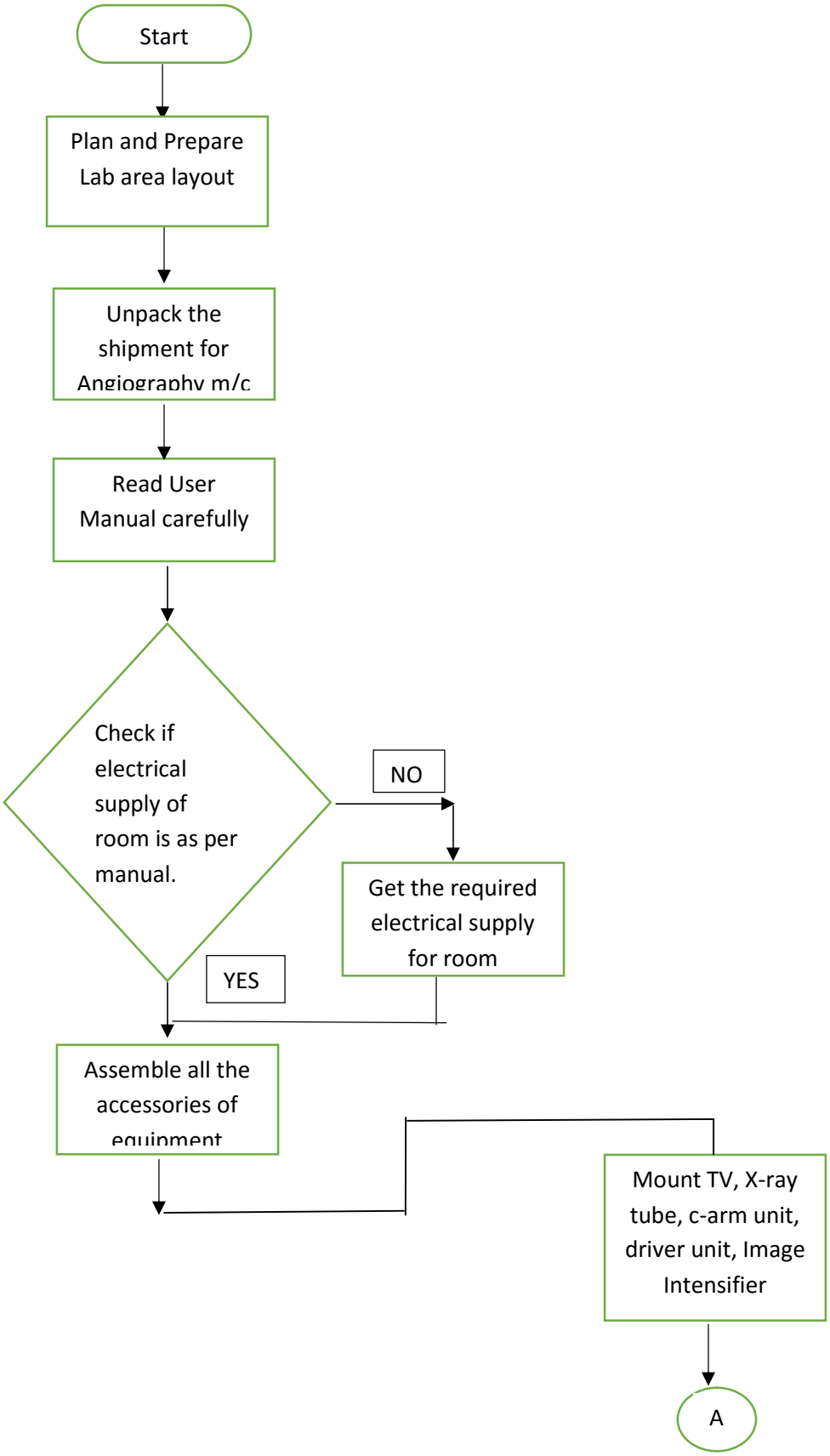
1) Newer technology transducers use phased array techniques to enable the ultrasound machine to change the direction and depth of focus.

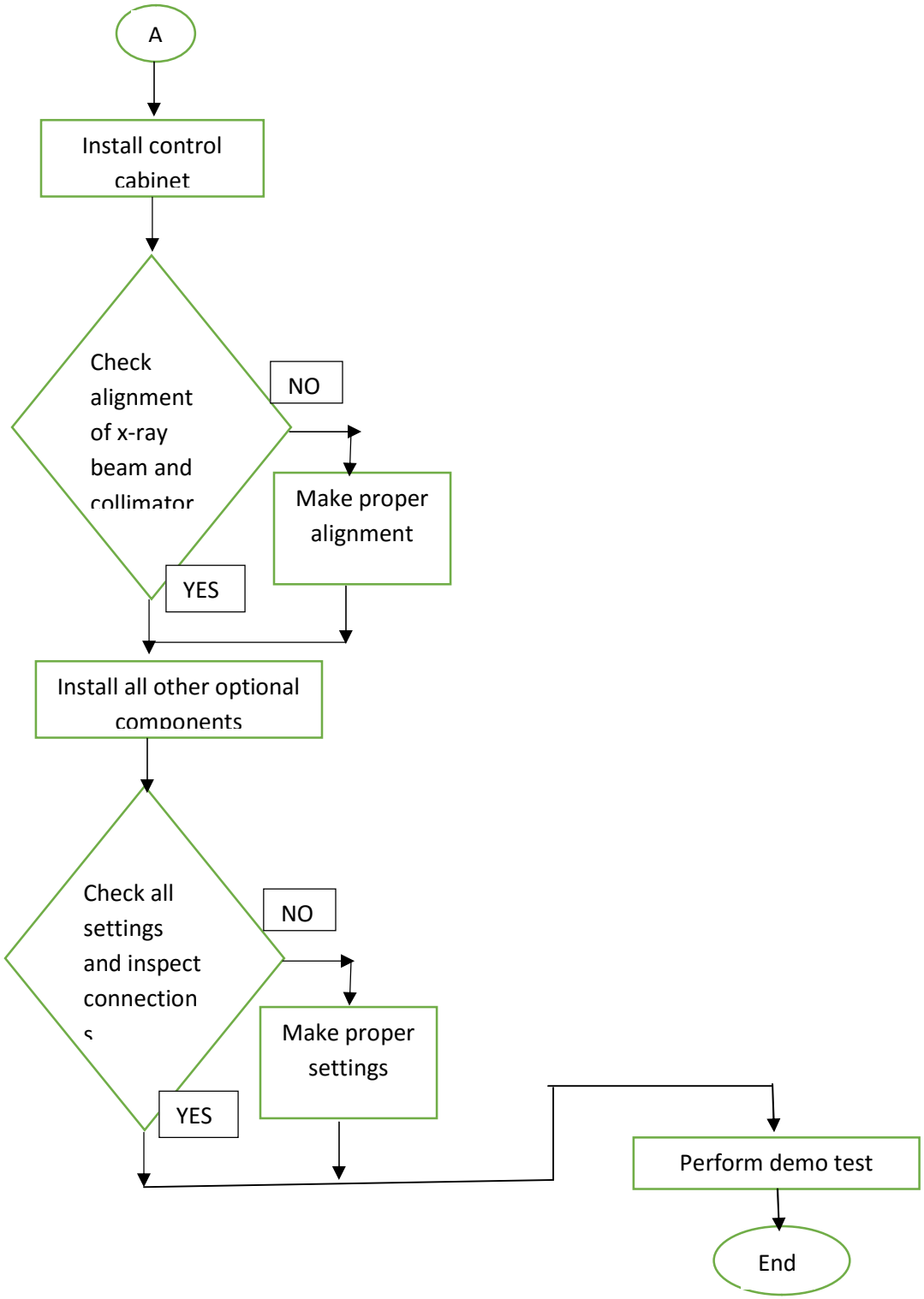
2) Storage capacity: As storage capacity is increased more number of images can be stored for future investigation.

	d)	**Is endoscopy an invasive or non-invasive imaging technique? Draw and label the parts of an endoscope machine.(2m+2m)** **Ans :** Endoscopic surgery uses scopes going through small incisions or natural body openings in order to diagnose and treat disease. Hence it is minimally invasive surgery (MIS), which emphasizes that diagnosis and treatments can be done with reduced body cavity invasion.  **Endoscopy Machine**	**4 Marks**
	e)	**State the causes of the faults occurring in an ultrasound scanner.(1m each)** • **Machine does not turn on.** • **Ultrasound does not generate properly.** • **Image quality is poor.** • **Display is poor** **Ans : i) Machine does not turn on** Cause**:** • No power from mains socket • Electrical cable fault **ii) Ultrasound does not generate properly.** Cause : Transducer problem, on board problems iii) **Image quality is poor.** **Cause:** • Insufficient gel • Controls set incorrectly • Main voltage is too low • Probe/display problem **iv)Display is poor** • CRT circuit problem • Main voltage is too low.	**4 marks**

Q4 .A)

d) Flow Chart for angiography machine




A
Install control cabinet
Check alignment of x-ray beam and collimator
NO
Make proper alignment
YES
Install all other optional components
Check all settings and inspect connection s
NO
Make proper settings
YES
Perform demo test
End